REMARKS/ARGUMENTS

Allowable Subject Matter

Applicant notes with appreciation that claims 3, 5, 10-13 and 17, 19 and 24-27 would be allowable if rewritten in independent form.

Amendments

The claims are modified in the amendment. More specifically, claims 1, 15, 29 and 30 have been amended. Therefore, claims 1-30 are present for examination. Applicant reserves the right to pursue any canceled subject matter in a continuing application without any prejudicial effect. No new matter is added by these amendments, which are fully supported by the specification. Applicant respectfully requests reconsideration of this application as amended.

35 U.S.C. §103 Rejection, Lin et al. in view of Fuchigami et al.

The Office Action has rejected claims 1, 2, 4, 6-9, 14-16, 18, 20-23 and 28-30 under 35 U.S.C. §103(a) as being unpatentable over the cited portions of U.S. Patent No. 6,006,174 to Lin et al. (hereinafter "Lin") in view of the cited portions of U.S. Patent No. 6,463,410 to Fuchigami et al. (hereinafter "Fuchigami"). Claims 1, 15, 29 and 30 are believed to distinguish over any combination of Lin and Fuchigami because a key limitation of these claims are neither taught nor suggested by Lin or Fuchigami. More specifically, Lin or Fuchigami do not teach or suggest lossless encoding or decoding using a set of binary representations that are optimized for the prediction samples. For at least this reason, the Applicants respectfully request reconsideration of the rejection to claims 1, 2, 4, 6-9, 14-16, 18, 20-23 and 28-30.

The claimed invention differs from Lin or Fuchigami in the way we are using predictive coding. As the Examiner notes, prediction is nothing new; it has been used for decades in coding of speech for example. But the conventional way to use prediction is to reduce the predictable redundancy of the signal. Each sample is predicted from past reconstructed samples and then encoded in some way. This constitutes the well-known linear predictive coding (LPC) scheme, for example.

In the claimed invention, we are using prediction in a novel way. Specifically, we use the probability distribution of the sample value given the predicted value (predicted from past reconstructed samples) to make the lossless encoding more efficient in one embodiment. This conditioned probability distribution of the sample is, generally, different for each predicted value. The lossless encoding technique is illustrated in the patent application through an embodiment that uses table look-ups, which can be the well known Huffman coding. Alternative lossless coding techniques can, of course, be applied instead in other embodiments (e.g., Arithmetic Coding).

To further understand the invention we consider the embodiment of table look-ups in more detail, since this method is easy to describe and understand. A plurality of tables is prepared in advance, one for each predicted value (or range of values) and each containing different bit-representations. Each of the tables is prepared using actual data that have an associated predicted value. The prediction is used to find which table is most beneficial to use to encode the data. That is, we perform lossless encoding of quantized digital samples using a set of binary representations that are optimized for the prediction samples, as stated in our first claim, to make the lossless coding more efficient in one embodiment.

Summary of Lin

Lin uses prediction in the conventional way, more specifically, to reduce the information in the signal that is predictable. In that way, Lin reduces the number of bits needed to represent the signal. The parts that are new in Lin include the producing of spectral coefficients and the usage of these coefficients. This objective is not at all related to the claimed invention, where we use prediction to find set of binary representations that helps selecting the best way for lossless encoding the signal. It is not clear why one of ordinary skill in the art would combine Lin's method with efficient lossless coding of the speech segments, since the coding is done in the residual domain, and not in the speech domain.

Summary of Fuchigami

Fuchigami discloses a frame-based method of lossless encoding/decoding of an audio signal. The input signal has two components L and R (representing a stereo signal). The two signals are added and subtracted from each other to form two new signals, L+R and L-R. Each of these two signals is encoded in the same way. A set of n different predictors is used on each signal. The predicted signals are subtracted from the original to form n different residual signals (Fuchigami, **15D1** and **15D2** in Fig. 2). A buffer and selector unit (Id. **16D1** and **16D2** in Fig. 2) selects one of the n residual signals to encode and packetize. The selection follows the steps of: searching each of the n residual signals for the highest absolute value and choosing the one with the lowest maximum absolute value. These steps are like a conventional prediction operation except that the maximum prediction error rather than the squared prediction error is minimized.

The maximum absolute value sets the number of bits needed to transmit the residual signal (within that frame) without losses. Note that this step of removing the most-significant bits is the actual lossless coding step in Fuchigami. The lossless coding of a residual sample in Fuchigami is based on the value of that sample and on additional knowledge of the maximum absolute value within the entire block. In contrast, in our invention the lossless coding of samples based upon both its actual value and additional knowledge in the form of the predicted value.

The proposed method from Fuchigami is limited to digitized signals where all possible values for the binary representation of each sample are allowed. This means that, in contrast to our method, a coarsely quantized signal (e.g. an ADPCM signal) can not be coded without losses using the Fuchigami method.

For at least these reasons, neither Lin nor Fuchigami teach or suggest lossless encoding or decoding using a set of binary representations that are optimized for the prediction samples. Reconsideration is respectfully requested.

35 U.S.C. §103 Rejection, Lin in view of Fuchigami and further in view of Lee et al.

The Office Action has rejected claims 6 and 20 under 35 U.S.C. §103(a) as being unpatentable over Lin in view of Fuchigami and further in view of the cited portions of U.S. Patent No. 5,511,094 to Lee et al. (hereinafter "Lee"). In addition to being allowable for the reasons given above for their parent claims, claims 6 and 20 have additional limitations not taught in Lin, Fuchigami or Lee. Specifically, claims 6 and 20 refer to the usage of a dequantizer before the predictor in the encoder/decode (for example, see Application Figs. 4a and 4b). The use of a dequantizer before prediction cannot be found by the Applicant in Lee. Should this rejection be maintained, a specific showing of where Lee teaches this idea is respectfully requested.

Interview Request

Should further action be required before allowance of this application, Applicant hereby requests an interview. The subject matter of this application is complex and discussing the issues before further action would be helpful in any further prosecution. The undersigned can be reached by telephone at 303-571-4000.

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance and an action to that end is urged. Reconsideration of the claims in their current form is respectfully requested.

Respectfully submitted,

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